White Paper

Consumer Insights about Gesture Interaction in Vehicles

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Consumer Insights about Gesture Interaction in Vehicles

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Abstract

In this paper we present the findings of two research clinics, which focused on user perception of gesture interaction in a vehicle. While one study focused on user experience and usability of pre-defined gestures, the other study focused on general consumer perception and expectations of gesture interaction. We conclude this paper with basic recommendations, which can help interaction designers to create a more enjoyable user interface.

1 Introduction

Social communication is more than just the spoken word. Non-verbal communication is a way for human beings to express meanings and the fact that people move their hands while talking is a phenomenon which can be observed across cultures and ages. Even babies start gesturing long before they can articulate a word (Goldwin-Meadow 1999). Although some may argue that the communicative value of gestures is low, or even non-existent (Krauss 1991), we observe that even blind people use gestures when communicating, although they have never seen themselves doing a gesture, while the listener they are talking to may be blind as well (Iverson 1998).

New technologies, such as time-of-flight (ToF) cameras, allow us to also use human hand gestures as an additional input modality in the vehicle cockpit. To understand how people want to use gestures in a vehicle and which gestures are most intuitive, substantial consumer research is needed. To start these research activities, Visteon implemented a gesture recognition system in a test vehicle as shown in Figure 1.

Figure 1: Hand gesture interaction within Visteon's test car

1.1 Investigation of Use Cases beyond Simple 3D Gestures

Because the ToF camera system provides - besides the amplitude image - also depth information, it can be used to do more than just detecting simple gestures (like a swipe or approach in a short range). The camera sees the details of the scene (i.e. number of visible fingers and pointing direction) and the exact position in 3D space. Therefore, the target is ready to realize a more natural human machine interaction (HMI) within a large interaction space.

Figure 2: Examples of hand gestures and hand poses for HMI interaction

Use cases such as hand pose detection, touch detection on display, and driver/co-driver hand distinction are already integrated and showcased in the technology vehicle to demonstrate the potential of the technology and enabling new ways of interacting with the vehicle (See also Figure 2).

2 Consumer Insight Studies

2.1 Usability Research Project

Prior to the ToF implementation in the car, a qualitative pilot study was conducted to identify users' expectations on gesture control in order to control specific car functions that could be implemented. Figure 3 depicts six use cases with their highest acceptance for gesture control. After the ToF technology was successfully implemented in the headliner of the test vehicle, a qualitative user research clinic was conducted to identify the ease of use and the efficiency of the developed system. In this approach, subjective user data and objective data were collected and evaluated. As this study was conducted with a small sample size of only 11 participants, it was not intended to present statistically significant research data at this point, but rather give an indication on how to approach the topic of in-vehicle gesture interaction.

The clinic was structured in 60 minute interviews applying a "think aloud" technique to gather data. Prior to testing, participants were shown an instruction video and introduced to general gestures. It was ensured that the selected participants drove more than 12,000 km per year in a new vehicle. As the gesture system was installed in a Ford C-Max, the conventional Ford C-Max controls were used as baseline for this study.

2.1.1 Time to goal

During a "time to goal" approach, participants were asked to perform pre-defined tasks with regular interaction modalities, such as switches, to compare with gesture interaction. The time to fulfill each task is measured and gives an indication about the efficiency of the two systems for each particular use case.

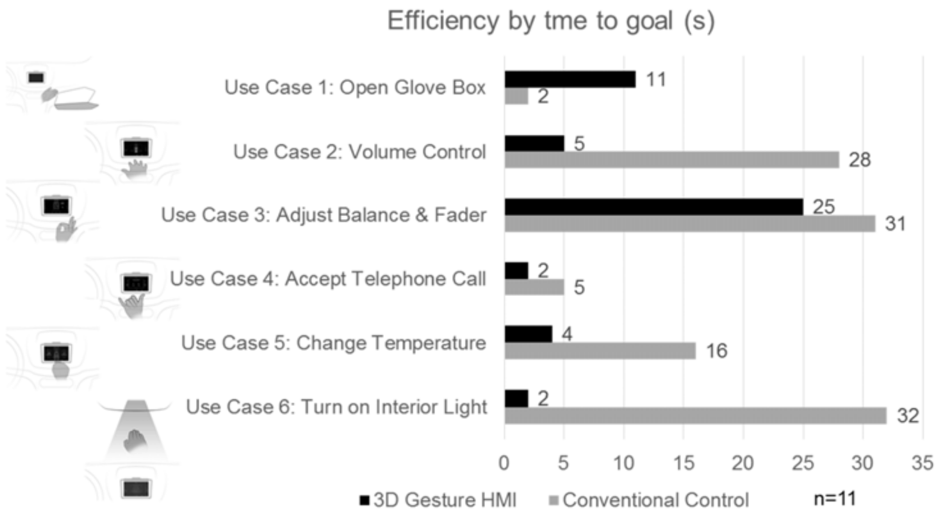

Figure 3: "Time to Goal" results for different use cases

Figure 3 visualizes the results of the six use cases presented during this clinic. In five out of six use cases the “time to goal” for gesture interaction is shorter than using conventional controls. During use case 1, the user opened the glove box by approaching the glove box with the hand. The gesture camera recognizes the approach and opens it automatically. Unfortunately, there was a learning curve to get the gesture right to the point where the system could understand it correctly. This resulted in a longer interaction time to reach the goal. In contrast, the conventional way to open the glove box was done without any mistakes by 100 percent of participants.

2.1.2 Task success rate

How successfully each task was completed is visualized in Figure 4. It becomes obvious that there are significant differences between the use cases - and, in some cases, the conventional control created more mistakes than the gesture interaction.

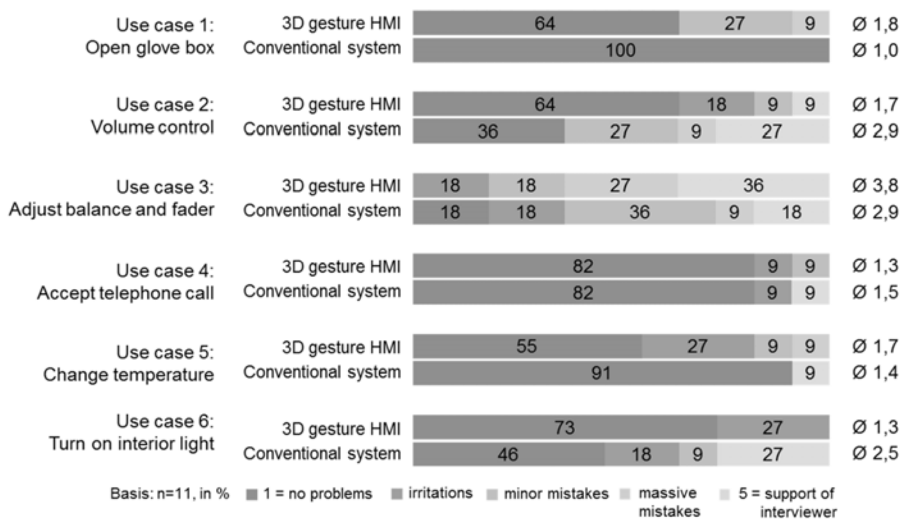

Figure 4: Results on success (objective)

2.1.3 User experience

In addition to the task completion time and measuring the success rate, we investigated the subjective perception of each use case. Participants were asked to rate their experience for each use case and each modality on a scale from 1 - being very good, to 5 - being very poor.

The results presented in Figure 5 show that for four out of six use cases, the gesture interaction was on average rated better than the conventional system. In general, we found that concepts of simple and “magical” use cases, which are providing added value, are rated highest. Therefore, turning on the light with a simple gesture was one of the most compelling use cases for the participants.

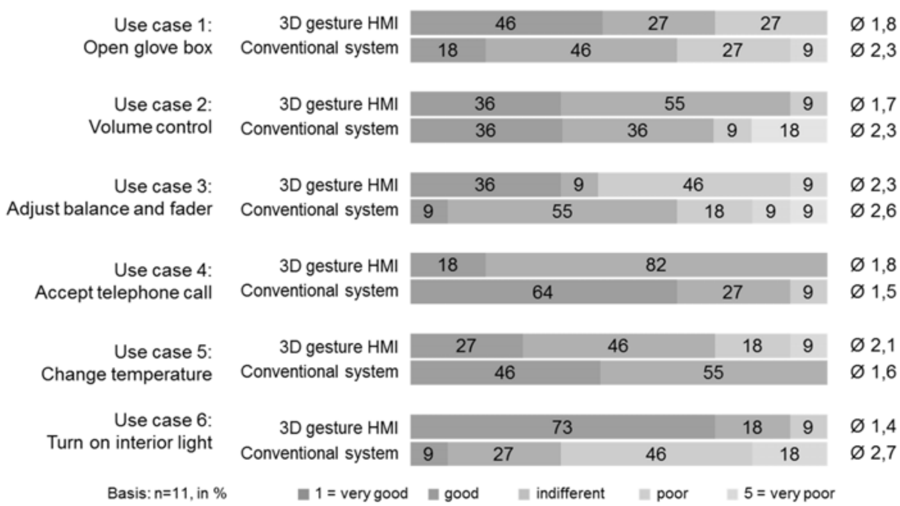

Figure 5: Results on user experience (subjective on concept)

2.2 Consumer Research Clinic

In addition to the first usability investigations, a consumer research clinic was conducted to test how the ToF gesture interaction fits to the ideal consumer experience. In total 45 consumers, 69 percent males and 31 percent females, participated in this research clinic. The majority of participants were D-segment drivers with 67 percent, 30 percent E-segment drivers, and 4 percent were driving a B-Segment car. About 40 percent were between the ages of 33 and 45, 27 percent were between 18 and 32 years old, and 33 percent were between 46 and 65 years of age.

2.2.4 Image of gesture interaction

To evaluate the image of gesture interaction, participants were asked what comes to their mind when they think about operating functions in the car using gestures. Concerns about gesture interaction prevailed from the start, which can be explained by the fact that this is still a very new and not yet widely experienced technology. Also, gesture interaction is also not common in current consumer electronics (CE) devices.

After unprompted discussion, participants were shown a video of the previously introduced gesture use cases, which were demonstrated in the test vehicle. Interviewers asked the consumers if and how they thought differently about gesture interaction after having seen the video. The results were sobering as the negative feelings were not reduced. People were skeptical about the technology’s precision and that it might cause more distraction.

2.2.5 Controlling functions with gesture

After the initial perception of gesture interaction was gauged, consumers were asked to control the functions inside the vehicle. Similarly to the usability research, it was measured to what extent participants could interact with the vehicle functions without further support.

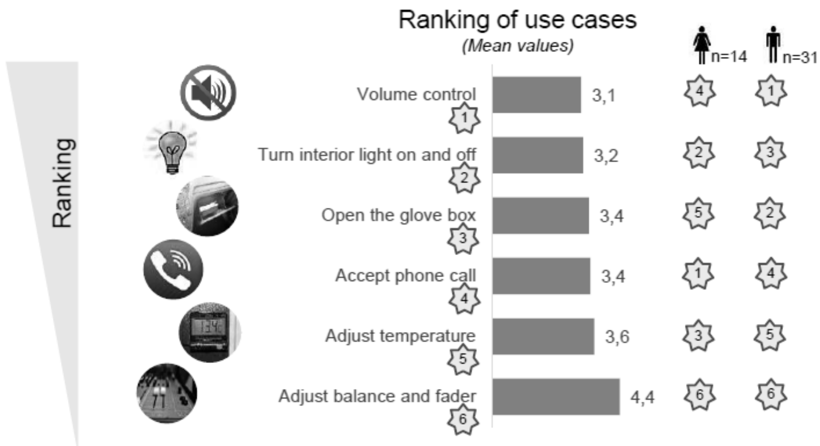

Figure 6: Ranking of use case preferences (overall, mean values, female ranking, and male ranking)

In spite of the initial skepticism, most participants did not have significant problems operating vehicle functions with gestures. Comparable to the results of the first clinic, turning on the interior light and accepting phone calls were the easiest use cases for consumers. Overall gesture interaction found acceptance with about half of the respondents, with only very little differences between the various use cases, as shown in Figure 6.

3 Conclusion

Overall the user research showed that gesture control can be more enjoyable than conventional interaction. However, it also became obvious that not all interactions with the vehicle should be substituted by gestures. Gesture control should only be offered for dedicated interactive functions and not for safety-relevant functions. Best experiences are established when focusing on natural and simple gestures with a feedback for each interaction step.

Additional cultural differences should also be considered when a system like this is introduced to the market. They do not only play a significant part in the judgmental evaluation but also a relevant part in gesture interaction. (van Laack 2014)

4 Literature References

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5 Authors

Dr. Alexander van Laack

As human-machine interaction (HMI) and technical design manager in Visteon's European design experience group, Dr. Alexander van Laack is responsible for developing strategies for the use of specialized, automotive-related HMI concepts. In his role, he leads driving simulated user experience research initiatives and is responsible for HMI and user experience concept implementation.

Dr. van Laack has more than eight years of automotive experience.

He previously held a position as research engineer at Ford Research and Advanced Engineering developing methodologies to measure user experience and quality perception of interiors and HMIs.

Dr. van Laack has a master's degree in business administration and engineering, as well as a PhD in engineering, from the RWTH University of Aachen in Germany.

Judy Blessing

Judy Blessing brings 17 years of research experience to her manager position in market and trends research. Her in-depth knowledge of all research methodologies allow her to apply the proper testing and analysis to showcase Visteon´s automotive intellect to external customers and industry affiliates. Judy holds a German University Diploma degree in Marketing/ Market Research from the Fachhoch-schule Pforzheim, Germany.

Judy Blessing has more than ten years of automotive experience, investigating topics like consumer perceived quality, user experience, usability and advanced product research.

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Gert-Dieter Tuzar, MFA

As Principal Designer HMI and Human Factors Expert in Visteon's European design experience group, Gert-Dieter Tuzar is responsible for Human Centered HMI Design Development Process and Interaction Concepts. In his role he leads HMI Design Development for Infotainment products, and Driver Information Systems.

Gert-Dieter Tuzar has more than twenty years of automotive experience. He has a Masters of Fine Arts degree from The Ohio State University, Columbus, OH, USA as well as a Diplom-Industrie-Designer (FH) degree from The University of Applied Science in Pforzheim, Germany.

Oliver Kirsch

As Innovation Project Manager in Visteon's European Advance Innovation Group, Oliver Kirsch is responsible for investigating new technologies from technology monitoring to proof of concept. In his role he investigates advanced camera technologies for interior applications with a focus on computer vision algorithms for Time of Flight based 3-D hand gesture recognition. Previously, he held roles in other areas of cockpit electronics like instrument clusters and head-up displays.

Oliver Kirsch applies more than twenty years of automotive engineering experience. He earned a degree in electrical engineering from the Bergische University Wuppertal, Germany.

Note: Co-author Oliver Kirsch's contributions to this paper were made during his previous employment at Visteon Corporation.

About Visteon

Visteon is a global company that designs, engineers and manufactures innovative cockpit electronics products and connected car solutions for most of the world's major vehicle manufacturers. Visteon is a leading provider of instrument clusters, head-up displays, information displays, infotainment, audio systems, and telematics solutions; its brands include Lightscape®, OpenAir® and SmartCore™. Visteon also supplies embedded multimedia and smartphone connectivity software solutions to the global automotive industry. Headquartered in Van Buren Township, Michigan, Visteon has nearly 11,000 employees at more than 40 facilities in 18 countries. Visteon had sales of $3.25 billion in 2015. Learn more at www.visteon.com.

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